INTRAOCULAR LENS WITH VAULTING HAPTIC

The present invention is related to the field of ophthalmology and more specifically to new intraocular lenses which have been found to considerably facilitate and improve the result of IOL implantation through a small incision.

BACKGROUND

A most common age related observation is that the visual acuity is reduced since the lens of the eye has become cloudy making the vision blurred. This opacification of the lens is called cataract and is caused by molecular rearrangement of the lens components with increased light-scattering. Some cataracts furthermore develop a yellow-brown colour due to pigment deposition which also contributes to reduction of vision.

Besides the most frequent cataracts, which occur in elderly people, the lens might also be affected due to diabetes or numerous types of injuries.

The only treatment of cataracts available is to remove the cloudy lens through surgery. Once the lens has been removed a new artificial lens is required so that the eye can focus clearly. There are three methods of restoring vision after cataract surgery: by cataract spectacles, by contact lenses or by implantation of intraocular lenses.

An intraocular lens implant is prepared from a biocompatible material, for instance polymethylmethacrylate (PMMA) or silicone, and is placed inside the eye by the surgeon in direct connection with the cataract removal.

Cataract surgery has changed dramatically over the past twenty years, principally as a result of introduction of the operating microscope, introduction of viscoelastic substances such as Healon ®, better instrumentation, improved surgical techniques and refinement of the intraocular lens implants as such. The state of the art methods are constantly being developed and improved.

Heretofore most intraocular lens implantations have involved first making an incision (1) in the cornea as indicated in FIG. **1** and then filling the anterior segment of the eye with a viscoelastic material. After that an IOL is inserted through the incision (FIG. **2**), manipulated past the iris (FIG. **3**) and then seated closely adjacent the posterior wall of the lens capsule (FIG. **4**). The IOL shown in FIGS. **2**–**4** has the two haptics attached to the lens at an angle α which is referred to as degree of angulation, which is shown in FIG. **5**. This angle is often about 10 degrees.

A surgical method gaining in popularity is the phacoemulsification technique, that utilises ultrasonic vibrations to fragment the lens nucleus, thus allowing removal of the lens material through an incision that is approximately 3 mm long. The benefits of a small incision are faster visual rehabilitation, faster healing and less astigmatism than with conventional large incisions. A hollow titanium needle with a diameter of about 1 mm is activated to vibrate by a magnetostrictive ultrasonic mechanism. The mechanical vibrations transform the lens into an emulsion, hence the name phacoemulsification.

As the phacoemulsification technique has been refined the construction of the incision has developed to allow sealing of the wound without the need for sutures—"self sealing incisions".

Such a self sealing incision is based on the valve being constructed through an internal lip of corneal tissue that is pressed towards the outer part of the wound by the internal pressure in the eye (see FIG. **6**). The valve can be made either entirely in the cornea, (3) ("clear cornea incision") or partly in the sclera (2) ("scleral tunnel incision"). The operation must be very accurately performed: for a corno-scleral tunnel the scleral incision is made 1–2.5 mm peripheral to limbus, that is the grey line separating the clear cornea from the white sclera. Using a knife with a rounded tip, a tunnel/valve is fashioned, about one half scleral depth and about 3 mm wide and 2 mm long. This is followed by the incision into the anterior chamber. Using a knife with a pointed tip the tunnel/valve is extended into the clear cornea another 1–2 mm with exactly the same careful precise motion. Following this procedure a very accurate valve construction is prepared. After removal of the opacified lens the incision is extended to the size required for the intraocular lens to be implanted, the anterior segment of the eye is filled with a viscoelastic material and the lens is implanted. Minimising the size of the lens during implantation is accordingly of great importance in order to allow the use of very small incisions, which are often referred to as tunnel incisions. The tunnel or small incision technique is described for instance in J Cataract Refract Surg 16(5) (1990) pp. 567–577 by Menapace, R. et al and in Ophthalmology (U.S.) 100(2) (1993) pp. 159–163 by Ormerod, L.D. et al.

A conventional incision (1) as shown in FIG. **1**, which is closer to the limbus, and which enters the anterior chamber straight does not have the advantages discussed above. Tunnel incision offers, for reasons mentioned above, great advantages, out it is of crucial importance that lenses suitable for the procedure are available. In this connection considerable efforts have been made to develop a foldable lens which can be deformed during the insertion step but which after insertion in the eye returns to the predetermined size. This concept is disclosed in U.S. Pat. No. 4,702,244 and U.S. Pat. No. 4,573,998.

One specific problem in connection with tunnel incision implantation has been identified. When a conventional IOL, which as mentioned above has about a 10° angulation, is implanted through a tunnel incision, the lens enters the eye at a different angle (see FIG. **7**) than when implanted through a regular incision in the cornea (see FIG. **1**). The problem is that the leading loop (or haptic) of the introcular lens has an angulation of 10 degrees and during insertion there is a risk of its touching the inside of the cornea (see FIG. **7**), which contains a layer of endothelial cells which are extremely sensitive to mechanical damage. The function of the endothelial cell layer is to allow the aqueous component into the cornea and to pump out excess fluid so that transparency is maintained. The pump is located in the cell membranes of the endothelium. The cells are hexagonal in shape and seem to be fitted together much as tiles on a floor. The hexagonal configuration minimises mechanical stress between units. Mechanical damage to the endothelial cells results in the mechanism described above being disturbed and can further cause cell death and if significant cell death occurs the cornea becomes edematous and opaque and corneal transplantation is required.

BRIEF LISTING OF THE DRAWINGS

FIG. **1** shows making an incision in the cornea.

FIG. **2** shows inserting a conventional IOL through the incision.